*SANDAKANIA 1 (1992) : 23-36*

# The Sabah Forestry Department's Arboretum at Sepilok, Sandakan

**Y.F. Lee & A. Berhaman**

Forest Research Centre, Sepilok,
P.O. Box 1407, 90008 Sandakan,
Sabah, Malaysia

**Summary**. The Sabah Forestry Department's Arboretum at Sepilok, Sandakan was set up in 1971. It occupies a lowland site with remnant stands of naturally occurring forest species, which provide a matrix for introducing planted indigenous trees from other areas. Plans for developing the Arboretum for conservation, display, education and scientific purposes are outlined.

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The Sabah Forestry Department Arboretum at Sepilok, Sandakan, is a relatively new facility established only in 1971. The idea of having such an arboretum has its basis in that a scientifically documented, living collection of indigenous trees, established within an existing framework of identified spontaneous trees on site, will serve as a good ancillary facility for research. The phenological behaviour, in particular reproductive phenology, of species of forestry interest can be monitored for specimens of known identity and age, as can such growth attributes as height and diameter growth. An arboretum of planted trees allows regular periodic monitoring of these attributes for a large variety of selected species at one site, greatly facilitating the logistics of such work. In addition to being a living research facility at close proximity to the Forest Research Centre, it allows students of tropical trees and visitors in general to observe and learn more about Sabah's indigenous plant species.

The substantial area of the arboretum, with an undulating topography, and the support possible from its own nursery facilities as well as the main botanical research facilities nearby at the Research Centre, make it extremely feasible as an *ex situ* conservation facility for a large variety of lowland forest species. The special importance of this aspect is high-lighted when it is considered that lowland forest areas are increasingly being fragmented and disturbed by timber harvesting. In time, the living collections built up will serve as a unique set of trees which are either specially conserved in the Sepilok Arboretum, or are interesting comparisons with their conspecifics that can only be found scattered elsewhere.

These notes are provided to give more information about the development of the Arboretum and are partly based on an earlier information paper (Lee 1986).

## Locality and general description

The Sabah Forestry Department Arboretum is situated at Sepilok on the east coast of Sabah, 25 km by road west of Sandakan, at longitude 117° 57' East and latitude 5° 53' North. The arboretum site consists of an area of 106.7 ha, of which 35.7 ha is occupied by the Forest Research Centre complex, the Forestry Training School, the research nurseries and the staff quarters. It has an undulating terrain ranging from 15 to 45 m above sea level.

The North-east Monsoon brings heavy rain to the area during December and January, but the South-west Monsoon does not give much rain in June/July. The mean annual rainfall around Sandakan is 3,148 mm. The mean daily temperature is about 27° C, with a tendency for the driest month, April, to have a slightly higher mean value. The mean monthly relative humidity is usually over 80% and minimum daily means rarely go lower than the low 70's. The average daily sunshine is about 6-7 hours with the highest average in April and the lowest in January.

Geologically, the arboretum site has been mapped as the Sandakan Formation, which consists of mudstone, sandstone and some siltstone with rare thin coal seams (Lee 1967). The dominant soils are Orthic Acrisols and Luvisols in the Silabukan Association (Acres & Folland 1975).

The vegetation of the area consists of logged-over lowland dipterocarp forest that includes good regenerating stands in which can be found suitable conditions for raising planted forest tree species. The dominant dipterocarps naturally growing in the arboretum are *Shorea angustifolia, S. parvifolia, S. johorensis, S. mecistopteryx, S. smithiana, Dipterocarpus applanatus, D. caudiferus, Dryobalanops lanceolata, Parashorea malaanonan and P. tomentella*. Common non-dipterocarps which occur in the area are *Intsia palembanica* and *Sindora beccariana* (Leguminosae), *Eusideroxylon zwageri* and *Litsea* spp. (Lauraceae), *Knema laurina* (Myristicaceae), *Macaranga beccarianus* and *Glochidion* spp. (Euphorbiaceae), *Calophyllum* spp. (Guttiferae), *Artocarpus dadah* and *Ficus* spp. (Moraceae), *Scorodocarpus borneensis* (Olacaceae), *Palaquium* spp. (Sapotaceae), *Campnosperma auriculata* (Anacardiaceae), *Castanopsis* spp. and *Lithocarpus* spp. (Fagaceae), *Heritiera simplicifolia* (Sterculiaceae), *Euodia* spp. (Rutaceae), *Canarium* spp. (Burseraceae), *Diospyros* spp. (Ebenaceae), *Eugenia* spp. (Myrtaceae) and *Barringtonia* sp (Lecythidaceae). A full list of species which have been recorded in the logged-over forest of the arboretum is given in Appendix 1.

## History of establishment

The idea of a botanical garden in Sandakan was mooted in the early sixties, when the then Forest Botanist, Dr W. Meijer, proposed an area of about 121.4 hectares (300 acres) in Kebun Cina at km 6, Sibuga Road, as a forest park. Some trails were established in the forest and a botanical guide to the proposed botanical garden has been written. When the proposal was rejected in 1965 it was suggested that the botanical garden be located at Mt Walker Forest Reserve.

A piece of land of area 106.7 ha adjacent to the Sepilok Forest Reserve was finally acquired in 1970 and subsequently gazetted as an arboretum in 1971. The location of the arboretum with respect to the Sepilok Forest Reserve is shown in Fig. 1.

A pioneering effort at *ex situ* orchid conservation was made when an orchid garden of about 0.8 ha was mooted in 1977 (Lamb 1991). Although the functions of orchid conservation are more organised at specialist gardens such as the Tenom Orchid Centre, the collection of about 200 species at Sepilok is still maintained and the orchid garden will be improved to include shade houses and display stands.

**Development of the Arboretum**

During the initial stage of establishment of the arboretum in the 1970s, the staff strength was not satisfactory, with fewer than 10 workers. Hence initial planting was carried out on an *ad hoc* basis. Consequently the plots established during the initial stage of development of the arboretum were not properly planned. Subsequently, in the 1980s, when the staff strength was increased to the present 46 supervisory staff and workers, it was possible to formulate a systematic plan for developing the arboretum.

Fig. 2 shows the layout of the arboretum at Sepilok. Plots No. 1 to 31 were established prior to formulation of the development plan. The trees planted in these plots are mostly commercial timber species, the seedlings of which were readily available at the time of establishment of the plots. Plots No. 31 to 36 have been planted with dipterocarps.

Each of Plots No. 51 to 141, of varying size, has been allocated to a particular family of trees. The criteria for allocation of areas for the different families are as follows:

(1) Families with commercial timber species are allocated larger areas than those without commercial species;

(2) Families with large trees which have no commercial value at present but are potential timber species are allocated larger areas than those with small trees only;

(3) Families with a large number of species are allocated larger areas than those with a small number of species.

Based on these criteria the tree families in Sabah are divided into three main groups and seven subgroups as follow:

*Group A* Many species are extracted commercially at present.

*Subgroup Aa* : Large families with a lot of commercial species.

*Subgroup Ab* : Small families or families with few commercial species.

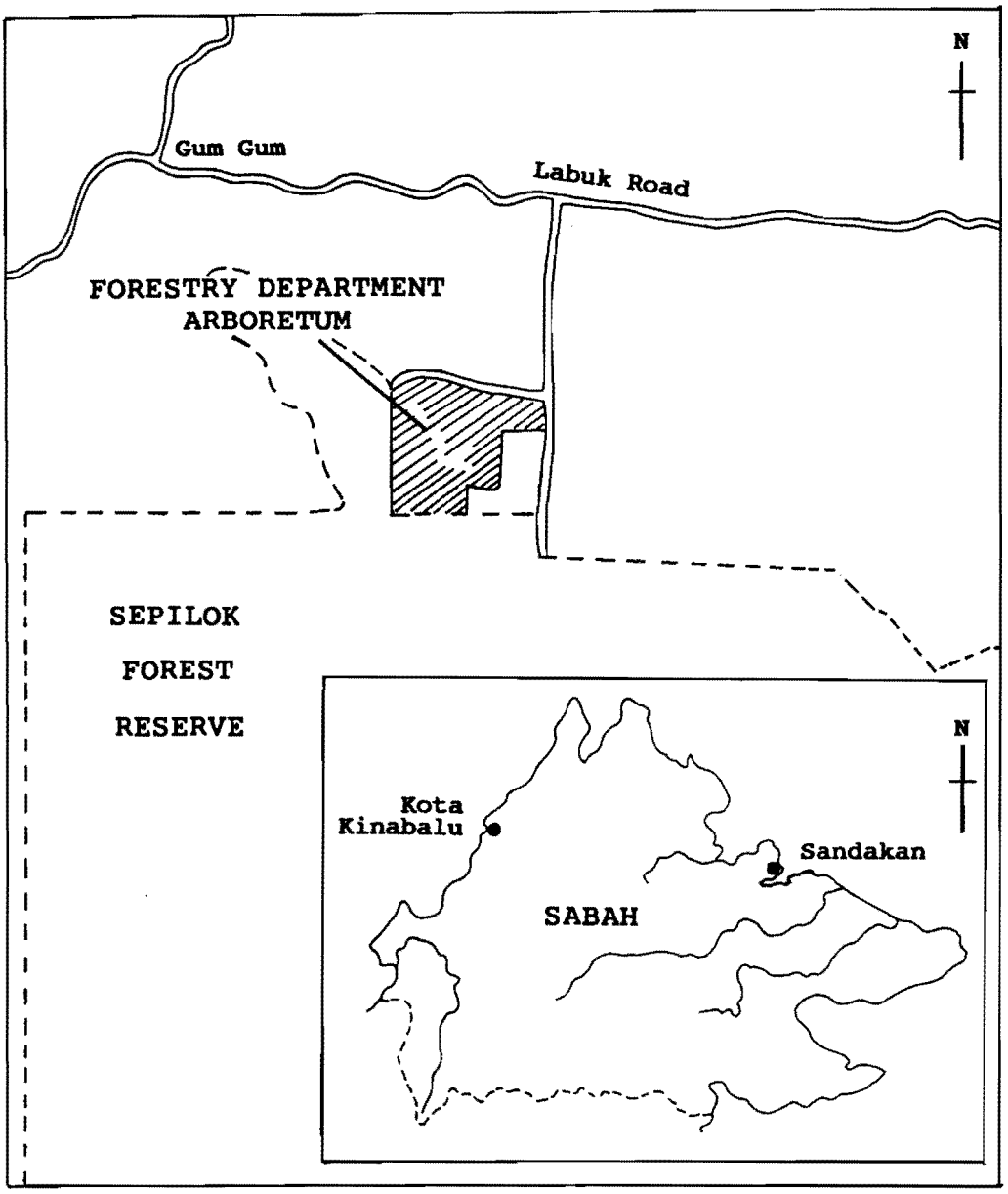


**Fig. 1.** Location of Sandakan (inset) and the Forestry Department Arboretum at Sepilok. Dashed line marks northern and western extent of the Sepilok Forest Reserve. Scale for larger map 1:50,000.

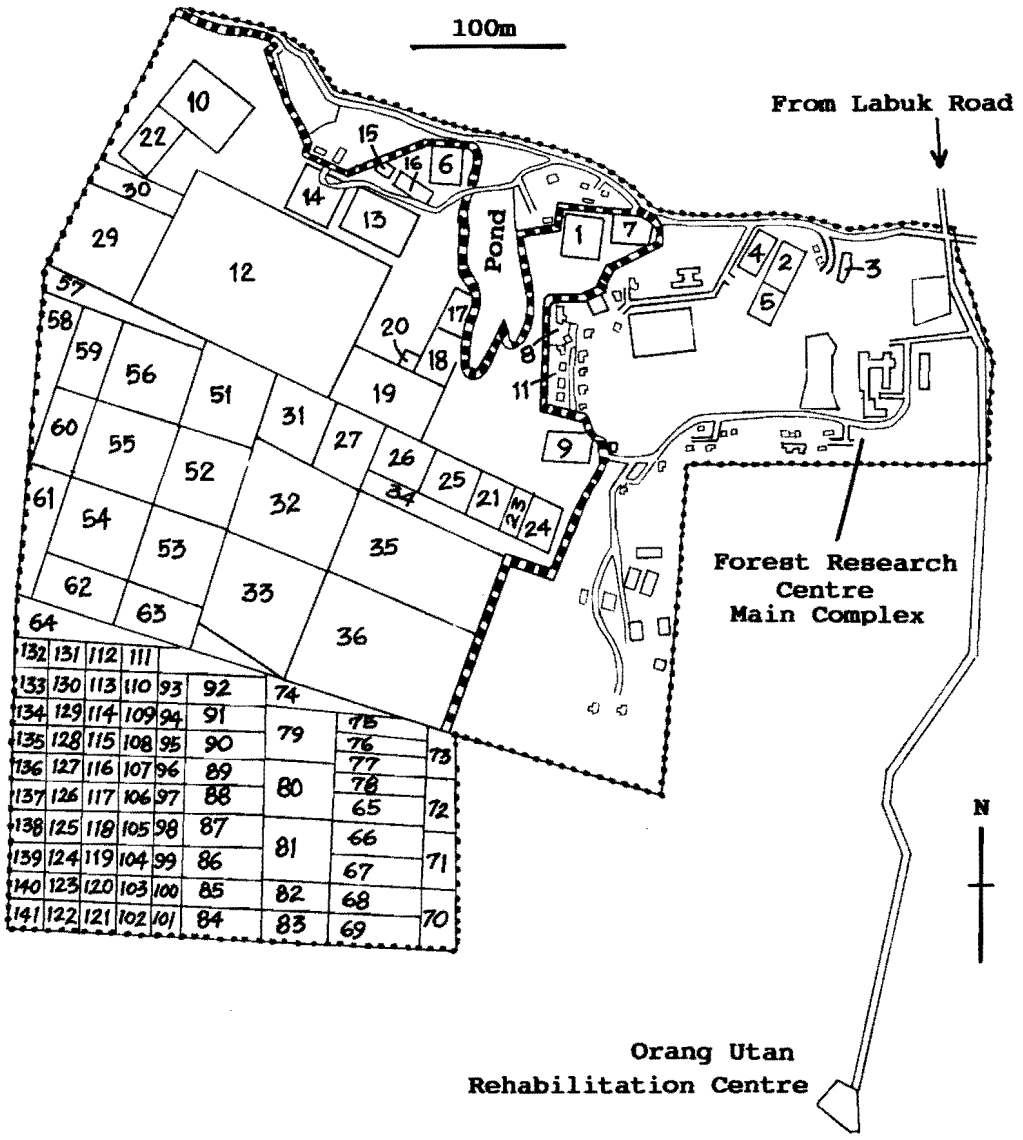


**Fig. 2.** Layout of the Arboretum at Sepilok. Dots mark boundary of the entire Arboretum area, including the main complex of the Forest Research Centre. Thick dashed bar marks eastern extent of the arboretum proper. Numbers indicate arboretum plots.

*Group B* Very few or no commercial species at present but there are some big trees which are potentially important timber species.

*Subgroup Ba* : Families with a large number of big trees.

*Subgroup Bb* : Families with few big trees.

*Group C* Virtually no potential timber species.

*Subgroup Ca* : Large families.

*Subgroup Cb* : Moderately large families.

*Subgroup Cc* : Small families.

A list of planted species which are now well established in Plots 1-36 is given in Appendix 2. Planted specimens in Plots 51-141 are still relatively young and are not listed here.

The canopy of a large part of the forest in the arboretum is dense. Before planting can be done, particularly for the light-demanding species, clearing is necessary. For the majority of timber species, spacing of 4-5 m between adjacent seedlings is suitable. Lines about 1 m wide and 4.5 m apart are cleared and seedlings are planted at intervals of 4.5 m along the lines. This technique is modified for the light-demanding species and small trees. The former may necessitate clearing a substantial area, and the latter can be planted at a narrower spacing of 3 m.

Gradual opening of the canopy of the logged-over forest is necessary as the young plants grow so that the planted trees will not be suppressed. Thinning is carried out subsequently and the optimum stocking is maintained at each stage of development of the plots.

**Continuing development**

The development of longer term plans for the Arboretum will be carried out according to the following considerations:

(a) The continuation of species procurement and specimen planting throughout the arboretum site, not neglecting the larger portion of the area (which may be called the "core scientific area") which as yet is accessible only for scientific work.

(b) The special development of an attractive facade at the entrance (where also in the long term an interpretation centre may be sited), leading almost immediately onto a ridge walk through a varied matrix of pre-existing and planted forest tree species that are well labelled with name plaques and judiciously provided with information

boards for the benefit of visitors. This walk can be developed to link up near to the orchid garden situated next to the Forest Research Centre complex, and can be served by a creatively written trail guide. This portion of the Arboretum may be called the "general visitor area", which is advantageously set apart from the core scientific area.

(c) The careful reorganisation of the Arboretum nursery along both functional and aesthetic lines. The nursery contains a large variety of natural forest tree seedlings, of great curiosity interest because of its adjacency to the entrance to the general visitor area. It will always carry a surplus of seedlings (because procurement requires that seeds in sufficiently large quantities are sown to ensure the germination of some, and final planting selects only a small number of seedlings, the rest being in excess and a potential liability in terms of storage space); these seedlings can form the basis of an exchange, sales or plant-donation programme with the public, with schools and with various agencies.

**Scientific functions**

About 40 ha of the arboretum area have already been planted; another 30 ha or so will comprise sufficient area for recieving further planting. Over the next ten years, planting will continue alongside building up of the records of height and diameter measurements of the arboretum trees. These will be of ancillary value to the silvicultural knowledge of local trees, when continued over longer periods.

A phenological trail with 200 tagged trees of various species is being periodically monitored, and will yield patterns of leaf exchange and reproductive rhythm for a number of selected forest species. In addition, many of the adult trees in this collection will also be able to serve as seed trees with known seeding periodicities.

More than 80 species of trees are found naturally growing in the arboretum area; in addition, by 1990 another 200 species have been planted. In the years ahead, a minimum of 20 additional species a year can be procured for the arboretum, so that after ten years some 480 species of tree, minimally, would have been procured; if we allow a 10% loss, we would still have about 430 species in the living collection. This will be close to 10% of the entire tree flora of Sabah, an amazing feat and highly useful scientific and conservation facility.

**Educational and recreational functions**

With sufficient funding and creative layout and development, the general visitor area can grow to be a highlight of the visitor's experience at Sepilok. The development of an informative trail system and guide, and possibly an interpretation centre, will ensure that students and general visitors learn something of the tree lore of Sabah's tropical rain forests. If developed and maintained conscientiously, this will indeed be a rare facility in the world.

The greater Sandakan area is fast shaping up as a region of great ecotourism interest; in relation to this a well-developed arboretum established so near to the already popular Orang Utan Rehabilitation Centre at Sepilok promises much attention from visitors and the general public. In an economic sense, the development of the arboretum along these lines is commensurate with the emergence of the greater Sandakan area as an important ecotourist destination, and so also contributes to the wealth represented by this growth.

## ACKNOWLEDGEMENTS

Mr K.M. Wong's comments, particularly on the development of the educational and recreational aspects of the Arboretum, are gratefully acknowledged.

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**Appendix 1**. Species found naturally in the Arboretum site.

| FAMILY | SPECIES |
|---|---|
| Anacardiaceae | *Campnosperma auriculata* |
| | *Dracontomelum puberulum* |
| | *Gluta* sp. |
| | *Koordersiodendron pinnatum* |
| Annonaceae | *Desmos* sp. |
| Apocynaceae | *Alstonia spatulata* |
| | *Dyera costulata* |
| Bombacaceae | *Durio* sp. |
| Datiscaceae | *Octomeles sumatrana* |
| Dilleniaceae | *Dillenia borneensis* |
| | *Dillenia excelsa* |
| Dipterocarpaceae | *Dipterocarpus caudiferus* |
| | *Dipterocarpus confertus* |
| | *Dipterocarpus grandiflorus* |
| | *Dryobalanops lanceolata* |
| | *Hopea nervosa* |
| | *Parashorea malaanonan* |
| | *Parashorea tomentella* |
| | *Shorea acuminatissima* |
| | *Shorea almon* |
| | *Shorea angustifolia* |
| | *Shorea fallax* |
| | *Shorea gibbosa* |
| | *Shorea inappendiculata* |
| | *Shorea johorensis* |
| | *Shorea leprosula* |
| | *Shorea macrophylla* |
| | *Shorea mecistopteryx* |
| | *Shorea parvifolia* |
| | *Shorea smithiana* |
| | *Shorea symingtonii* |
| | *Shorea xanthophylla* |
| | *Vatica* sp. |
| Ebenaceae | *Diospyros* sp. |

**Appendix 1 (cont'd)**

| | |
|---|---|
| Elaeocarpaceae | *Elaeocarpus stipularis* |
| | *Elaeocarpus* sp. |
| Euphorbiaceae | *Baccaurea bracteata* |
| | *Baccaurea lanceolata* |
| | *Baccaurea* sp. |
| | *Glochidion* sp. |
| | *Macaranga beccarianus* |
| Fagaceae | *Castanopsis motleyana* |
| | *Castanopsis* sp. |
| | *Lithocarpus* sp. |
| Flacourtiaceae | *Hydnocarpus woodii* |
| | *Pangium edule* |
| Guttiferae | *Calophyllum* sp. |
| | *Garcinia mangostana* |
| | *Garcinia parvifolia* |
| Lauraceae | *Eusideroxylon zwageri* |
| | *Litsea* sp. |
| Leguminosae | *Dialium* sp. |
| | *Intsia palembanica* |
| | *Sindora beccariana* |
| | *Sindora irpicina* |
| | *Sympetalandra borneensis* |
| Lecythidaceae | *Barringtonia* sp. |
| Melastomataceae | *Pternandra coerulescens* |
| Meliaceae | *Dysoxylum* sp. |
| | *Lansium domesticum* |
| Moraceae | *Artocarpus anisophyllus* |
| | *Artocarpus dadah* |
| | *Ficus* sp. |
| Myristicaceae | *Knema laurina* |
| Myrsinaceae | *Ardisia elliptica* |
| Myrtaceae | *Eugenia* sp. |

**Appendix 1 (cont'd)**

| | |
|---|---|
| Olacaceae | *Ochanostachys amentacea*<br>*Scorodocarpus borneensis* |
| Oleaceae | *Linociera pluriflora* |
| Rubiaceae | *Neolamarckia cadamba*<br>*Neonauclea bernardoi* |
| Rutaceae | *Euodia* sp. |
| Sapindaceae | *Nephelium ramboutan-ake*<br>*Paranephelium nitidum*<br>*Pometia pinnata* |
| Sapotaceae | *Mimusops elengi*<br>*Palaquium* sp. |
| Sterculiaceae | *Heritiera simplicifolia*<br>*Pterospermum* sp. |
| Thymelaeaceae | *Gonystylus bancanus* |
| Tiliaceae | *Microcos crassifolia*<br>*Pentace* sp. |
| Verbenaceae | *Guensia pentandra* |

**Appendix 2** List of planted trees in Plots 1-36 of the Arboretum.

| FAMILY | SPECIES |
|---|---|
| Alangiaceae | *Alangium* sp. |
| Anacardiaceae | *Dracontomelum puberulum*<br>*Gluta wallichii*<br>*Koordersiodendron pinnatum*<br>*Mangifera odorata*<br>*Mangifera* spp. |
| Araucariaceae | *Agathis borneensis* |
| Bignoniaceae | *Spathodea campanulata* |
| Bombacaceae | *Durio zibethinus*<br>*Durio* spp.<br>*Neesia* sp. |
| Burseraceae | *Canarium* sp. |
| Casuarinaceae | *Casuarina nobile* |
| Chrysobalanaceae | *Parinari* sp. |
| Combretaceae | *Terminalia* sp. |
| Dilleniaceae | *Dillenia excelsa* |
| Dipterocarpaceae | *Anisoptera costata*<br>*Dipterocarpus caudiferus*<br>*D. exalatus*<br>*D. grandiflorus*<br>*Dipterocarpus* spp.<br>*Dryobalanops lanceolata*<br>*Parashorea malaanonan*<br>*P. tomentella*<br>*Shorea almon*<br>*S. foxworthyii*<br>*S. irpicina*<br>*S. johorensis*<br>*S. leprosula*<br>*S. macrophylla*<br>*S. mecistopteryx*<br>*S. multiflora*<br>*S. parvifolia* |

**Appendix 2 (cont'd)**

| | |
|---|---|
| | *S. pauciflora* |
| | *S. seminis* |
| | *S. smithiana* |
| | *S. stenoptera* |
| | *S. venulosa* |
| | *S. waltonii* |
| | *S. xanthophylla* |
| | *Vatica sarawakensis* |
| Ebenaceae | *Diospyros discocalyx* |
| | *Diospyros* sp. |
| Euphorbiaceae | *Baccaurea macrocarpa* |
| | *B. motleyana* |
| | *B. puberulum* |
| | *Baccaurea* spp. |
| | *Elateriospermum tapos* |
| | *Mallotus* sp. |
| | *Ptychopyxis arborea* |
| Fagaceae | *Quercus argentata* |
| | *Q. gemelliflora* |
| Flacourtiaceae | *Hydnocarpus borneensis* |
| | *H. woodii* |
| Guttiferae | *Calophyllum* spp. |
| | *Garcinia mangostana* |
| | *Garcinia* sp. |
| Lauraceae | *Eusideroxylon zwageri* |
| Lecythidaceae | *Barringtonia* sp. |
| | *Planchonia valida* |
| Leguminosae | *Adenanthera pavonina* |
| | *Albizia lebbeck* |
| | *Albizia pedicellata* |
| | *Archidendron ellipticum* |
| | *Cassia fistula* |
| | *Cynometra mirabilis* |
| | *Intsia palembanica* |
| | *Intsia retusa* |
| | *Koompassia excelsa* |
| | *Parkia* sp. |
| | *Sindora* sp. |

**Appendix 2 (cont'd)**

| | |
|---|---|
| | *Sympetalandra borneensis* |
| Magnoliaceae | *Aromadendron nutans* |
| Meliaceae | *Aglaia* sp.<br>*Chisocheton* sp.<br>*Melia azedarach*<br>*Walsura villamilii* |
| Moraceae | *Artocarpus anisophyllus*<br>*Artocarpus* sp.<br>*Ficus callosa* |
| Myristicaceae | *Knema laurina*<br>*Knema* sp.<br>*Myristica* sp. |
| Myrtaceae | *Eugenia* spp.<br>*Psidium guajava* |
| Nyctaginaceae | *Pisonia grandis* |
| Olacaceae | *Scorodocarpus borneensis* |
| Rubiaceae | *Neolamarckia cadamba* |
| Rutaceae | *Citrus macroptera*<br>*Citrus* sp.<br>*Murraya* sp. |
| Sapindaceae | *Dimocarpus longan*<br>*Nephelium lappaceum*<br>*N. ramboutan-ake* |
| Sapotaceae | *Palaquium* sp. |
| Sterculiaceae | *Sterculia macrophylla* |
| Thymelaeaceae | *Gonystylus* sp. |
| Tiliaceae | *Pentace* sp. |
| Verbenaceae | *Tectona grandis*<br>*Teijsmanniodendron pteropodum* |